

# Notes - All About i

i - imaginary number

Definition  $i = \sqrt{-1}$  or  $i^2 = -1$

→ Now we can take  $\sqrt{\phantom{x}}$   $\sqrt[4]{\phantom{x}}$  even root of a negative number, but the answer is imaginary

Complex number  $a + bi$

Ex:  $6 + 3i$   
           $\uparrow$            $\uparrow$   
          real      imaginary

## Square roots of negative numbers

→ need  $i$  to  $\sqrt{\quad}$  a negative!

$$\text{Ex 1: } \sqrt{-9} = \sqrt{9} \sqrt{-1} = 3i$$

$\xrightarrow{\text{since } -9 = 9 \cdot (-1)}$ 
 $\xrightarrow{\text{simplified each } \sqrt{\quad}}$

$$\text{Ex 2: } \sqrt{-25} = \sqrt{25} \sqrt{-1} = \boxed{5i}$$

$$\text{Ex 3: } \sqrt{-4x^2} = \sqrt{4} \sqrt{-1} \sqrt{x^2} = 2xi$$

Do:

$$1) \sqrt{-49}$$

$$2) \sqrt{-144}$$

$$3) \sqrt{121}$$

$$4) \sqrt{-36y^2}$$

## Adding and Subtracting Complex Numbers

a Complex number :  $a + bi$

$\nearrow$  real component  
(no  $i$ )

$\nwarrow$  imaginary component  
( $i$ )

$$\text{Ex: } 3 + 2i, 8 - 7i$$

■ To add or subtract complex numbers, just treat  $i$  like a variable and combine like terms!

$$\text{Ex 1: } (3 + 2i) + (5 + 6i) = \boxed{8 + 8i}$$

$\nearrow 3+5$ 
 $\nwarrow 2i+6i$

$$\text{Ex 2: } (5 + 3i) - (2 - 4i) = \boxed{3 + 7i}$$

$\nearrow 5-2$ 
 $\nwarrow 3i-(-4i)$

$$\text{Do: } 1) (5 + 6i) + (9 + 3i)$$

$$2) (7 + 4i) + (3 - 5i)$$

$$3) (6 - 2i) - (4 + 7i)$$

$$4) (-2 + 3i) - (6 - 8i)$$

## Multiplying Imaginary Numbers

- Do the first steps like normal
- When you get  $i^2$ , simplify  $i^2 = -1$

Ex 1:  $(6i)(2i) = 12i^2 = 12(-1) = -12$

Ex 2:  $(-4i)(3i) = -12i^2 = -12(-1) = 12$

Ex 3:  $f(x) = 2x^2 + 1$ , find  $f(3i)$

$$\begin{aligned} f(3i) &= 2(3i)^2 + 1 \\ &= 2(9i^2) + 1 \\ &= 18i^2 + 1 \\ &= 18(-1) + 1 = -18 + 1 = \boxed{-17} \end{aligned}$$

Do:

1)  $(-4i)(5i)$

2)  $(10i)(3i)$

3)  $f(x) = 3x^2 - 4$ , find  $f(2i)$

## Multiplying Complex #s

- Do all of the first steps like normal!
- At the end, make  $i^2 = -1$  and keep simplifying

Ex 1:  $(2 + 4i)(3 - i)$

$$= 6 - 2i + 12i - 4i^2$$

$$= 6 + 10i - 4i^2$$

$$= 6 + 10i - 4(-1)$$

$$= 6 + 10i + 4$$

$$= \boxed{10 + 16i}$$

Ex 2:  $(-4 + 5i)(-4 - 5i)$

$$= 16 + 20i - 20i - 25i^2$$

$$= 16 - 25i^2$$

$$= 16 - 25(-1)$$

$$= 16 + 25$$

$$= \boxed{41}$$

Do:

1)  $(6 + 4i)(9 - 3i)$

2)  $(2 - 6i)(2 + 6i)$